

existing needle geometry was used to regenerate new treatment plans for three radiation schemes: 1x19.0Gy, 1x19.5Gy and 1x20Gy. All plans were optimized according to the following objectives:

Prostate V100% \geq 95% Prostate D90% \geq 100%

Bladder D1cc < 16.0 Gy Bladder D2cc < 15.5 Gy

Rectum D1cc < 15.5 Gy Rectum D2cc < 14.5 Gy Rectum V100% 0 cc

Urethra D0,1cc < 21.0 Gy Urethra D10% < 20.5 Gy Urethra V120% 0 cc

A total of 90 plans were generated using an inverse planning module. The planning target volume (PTV) was the prostate without margins. The coverage of the prostate was maximized considering the dose constraints for the organs at risk (OAR). The primary end point of this study was the feasibility of above mentioned target coverage and OAR constraints. The secondary end point was to investigate the restricting factors to reach a feasible plan stratified to prostate volume, OAR position and implant geometry.

Results: The average prostate V100% for the 19.0, 19.5 and 20.0Gy schemes was 96.6%, 95.3% and 93.0% respectively with 83%, 57% and 33% of plans meeting this objective. The D90% of the prostate averaged 20.3 Gy, 20.3 Gy and 20.4 Gy respectively. Only 4 plans failed this objective.

The 40-70cc group showed an average prostate V100% of 96.3% an increase of 2.1% and 2.7% compared to the < 40cc and >70cc group respectively.

The number of needles had no influence on prostate coverage and urethra constraints. The rectum and bladder D1cc and D2cc increased for the 17-22 needle group with 5.7%, 8.6% and 3.3%, 5.3% respectively.

The average prostate V100% decreased in patients with a larger distance between the urethra and the posterior border of the prostate.

Prostate V100% increased from 95.7% to 97.5% in patients with a prostate to rectum distance of 2mm or more.

Conclusion: Single fraction HDR brachytherapy as monotherapy in patients with prostate cancer is feasible using our current implant geometry. Considering the OAR constraints, an acceptable D90% was reached in 96% of plans. Prostate volume, implant geometry and OAR proximity have a substantial impact on target coverage.

OC-0558

Automated VMAT planning in prostate cancer patients using a Single Arc SIB Technique

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Purpose or Objective: To evaluate the feasibility of automated single arc treatment planning for prostate cancer patients using a commercially available treatment planning system. We also compared the resultant AutoplanningTM plans with our current institutional inverse planned prostates.

Material and Methods: A technique was created within the AutoplanningTM module of the PinnacleTM treatment planning system using institutional prescription dose/fractionation and OAR constraints to be delivered with a single arc VMAT plan. The Planning Target Volume PTV1 (74Gy) encompasses the prostate; PTV2 (66.6Gy) encompasses the prostate and the base or full seminal vesicles plus setup margins both delivered simultaneously in 37 fractions. Plans were generated for 10 randomly selected patients with prostate cancer treated at our institution, using the automated treatment technique template. Plan quality was assessed using institutional criteria and ICRU 83 criteria: D98, D2, Conformity Index (CI), Homogeneity Index (HI) and Remaining Volume at Risk (RVR). OAR constraints for rectum D65<30%, Bladder D50<50%, Femoral Heads, D50< 50%. Bowel D50<50cc, D55<14cc and D60< 1cc were assessed. The time for planning was also documented.

The ten AutoplanningTM technique plans were compared with clinical institutional VMAT prostate plans in a blinded study.

Plans were compared by Clinical Oncologists, assessing clinical coverage of the PTVs, OAR sparing and DVH parameters.

Results: Table 1 summarises results of the automated plan generation. The automated technique produced highly conformal plans that met institutional clinical constraints for 7 of 10 plans in a single run. In the 3 cases that failed, overlap of the PTV with rectum or bowel exceeded institutional DVH goals (Fig 1). There were no significant differences between the two planning techniques when comparing CI and HI.

Volume	Dose	Vol (%)	Mean	SD
PTV				
PTV1 (Min)	D63.27	98	99.81	+/-0.395
PTV1 (Max)	D75.48	2	0.13	+/-0.108
PTV2 (Min)	D70.3	98	99.99	+/-0.031
PTV2 (Max)	D70.0	2	0.04	+/-0.005
CI PTV1			1.17	+/-0.06
CI PTV2			1.09	+/-0.02
HI PTV1-2			0.012	+/-0.006
HI PTV2			0.035	+/-0.00
RVR (Mean -Gy)			23.369	+/-4.93
OAR				
Rectum	D65	<30	17.61	+/-3.964
Bladder	D50	<50	17.11	+/-5.748
Femoral Heads	D50	<50	0	+/-0
Bowel	D4.5	<50	18.82	+/-19.44

Table 1 Dosimetric Results for PTV and OAR with Automated Planning Technique

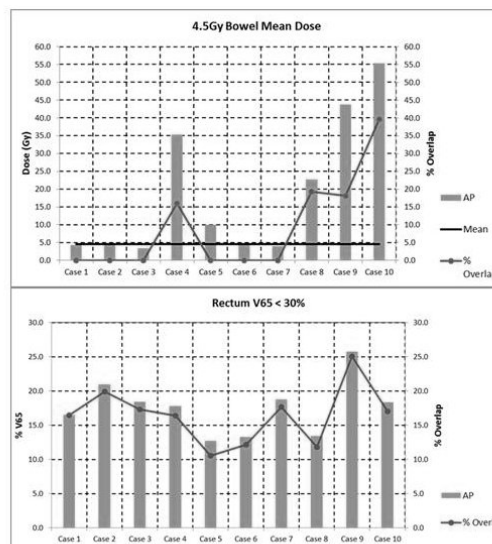


Fig 1. Impact of PTV overlap on Mean OAR doses for automated planning technique.

Conclusion: The automated technique for VMAT planning for prostate cancer is a promising solution which is feasible and may improve efficiency by automating cases that meet institutional dose volume constraints. We will present the results of the blinded plan selection study at the meeting.

OC-0559

The impact of rectal interventions on target motion and rectal variability in prostate radiotherapy

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Purpose or Objective: Target position is variable during fractionated prostate radiotherapy, mainly due to rectal changes. Margin reduction is preferable with the advancements of modulated techniques and IGRT. However, geometric uncertainty can persist in the absence of an intervention to minimise rectal motion. The purpose of this study is to retrospectively evaluate the effectiveness of three rectal emptying strategies in maintain rectal stability and reducing target motion during prostate radiotherapy.

Material and Methods: Four cohorts of consented prostate patients (total n=37) underwent different rectal strategies: daily phosphate enema; low-fibre diet and microlax microenema and no intervention (control). Using retrospective CBCT data, (8 CBCTs per patients), inter-fraction PTV motion relative to bony anatomy was measured using automatic bone anatomy registration, followed by an automatic Structure Volume of Interest (SVOI) match. Changes in rectal diameter (RD) at the base, mid and apex of the prostate and rectal volume (RV) were measured using the CBCT data. Frequency of prostate geometric miss was assessed, with a miss defined as any PTV shift in any direction.

Results: PTV displacement was significantly reduced in the anteroposterior (AP) direction in the microlax group ($p=0.004$), and in the superoinferior (SI) direction in the phosphate enema group ($p=0.013$) when compared with the control group (Table 1). The frequency of geometric miss was lowest in the microlax group. RD variability at the base of prostate was significantly smaller in the microlax and phosphate enema groups compared to the control group stats, and variation in RV was smallest in the microlax group. PTV motion and rectal variability were largest in the control group.

Table 1: Mean (μ), Systematic (Σ), and Random (δ) PTV displacements (mm) in the anteroposterior (AP), superoinferior (SI) and left-right (LR) directions for each group. Negative values indicate posterior, inferior and left PTV displacements from bony anatomy.

	Daily Phosphate Enema n=9			Microlax Microenema n=8			Low-Fibre Diet n=10			No Intervention (Control) n=10		
	AP	SI	LR	AP	SI	LR	AP	SI	LR	AP	SI	LR
μ (mm)	-1.2*	0.3*	-0.1	-0.7*	-0.6	0.3	-1.1*	-1.3	-0.2	-2.6*	-1.9*	0.3
Σ (mm)	0.6	1.6	0.6	0.6*	0.4*	0.6	1.0	1.1	1.1	1.6*	1.9*	0.7
δ (mm)	1.4	1.0	0.5	0.8*	0.9	0.6	1.5	1.7	0.7	2.0*	1.6	0.9

*Significant difference ($p<0.05$) when compared with the control group statistics.

Conclusion: Microlax microenema is an effective intervention in maintaining rectal stability, and PTV motion during prostate radiotherapy, in patients with large RD (4cm) on planning CT.

OC-0560

Plan of the day approach in post prostatectomy radiation therapy

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Purpose or Objective: Our primary aim is to investigate the frequency of using smaller margins for post prostatectomy radiotherapy (RT) in conjunction with daily soft tissue image guided radiotherapy (IGRT). Our secondary aim is to assess the feasibility of implementing an adaptive, 'plan of the

day', treatment approach by selecting an appropriate plan on a daily basis which will highly conform to the target and minimise rectal and bladder toxicities.

Material and Methods: Retrospectively identified 19 post prostatectomy patients. Soft tissue matching guidelines were created and split into two categories; patients with or without surgical clips. Soft tissue match was performed on cone-beam CT (CBCT) in offline review program by two radiation therapists and reviewed by two radiation oncologists. The frequency of geographic miss was measured using a planning target volume (PTV) small with a 5 mm clinical target volume (CTV) expansion and PTV large with 10 mm (15 mm anteriorly) CTV expansion. To implement a 'plan of the day' treatment approach, a post prostatectomy soft tissue training module was developed to educate the radiation therapists to perform daily soft tissue alignment. Radiation therapists will then apply an adaptive RT regime that selects from a plan library to account for internal organ inconsistencies of the bladder and rectum.

Results: A total of 135 CBCTs were reviewed on 19 radical post prostatectomy patients including those with lymph node involvement. Retrospective soft tissue match analysis determined that PTV small covered the target for 84% of CBCTs while the PTV large covered the target for 16%. There was no geographic miss outside PTV large in this retrospective analysis. In the matches that resulted in the selection of PTV large, 12% of CBCTs were due to variations in bladder filling and 4% from rectal filling.

Conclusion: PTV small is suitable for use on most CBCTs with PTV large selected for only a small portion of CBCTs. Very small bladders caused a greater amount of bladder and small bowel to fall in the target and increases the chance of side effects but rarely causes a geographic miss. Over filling bladders on CBCTs was undesired as it caused internal pelvic tilt in the superior portion resulting in a selection of the plan with PTV large. A dangerous combination is present if there are inconsistencies to both the bladder and rectum filling causing the CTV prostate bed region to tilt and fall outside of the target. With a high frequency of using PTV small, and a better understanding of the effect of bowel and bladder filling, implementation of 'plan of the day' is feasible. This will result in a highly targeted treatment delivery in conjunction with soft tissue IGRT that will reduce toxicities and increase local control.

Poster Viewing : 12: Physics: Dose measurement and dose calculation III

PV-0561

Validation of an optimised MC dose prediction for low energy X-rays intraoperative radiation therapy

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Purpose or Objective: Low energy X-rays Intra-Operative Radiation Therapy (XIORT) is increasingly used in oncology, predominantly for breast cancer treatments with spherical applicators [1], but also for skin or gastrointestinal cancer [2] with surface and flat applicators. This study aims to validate a fast and precise method [3,4] to calculate Monte Carlo (MC) dose distributions with an optimized phase space file (PSF) obtained from a previously stored database of monochromatic PSF and depth dose curves (DDP) for different INTRABEAM® (Carl Zeiss) applicators. To validate this procedure, we compared dose computed with the PSF with measurements in phantoms designed to prove actual XIORT scenarios.

Material and Methods: PSF were optimized from experimental DDP in water and were employed to calculate dose distributions, first in water, then in validation phantoms